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BULLETIN

OF THE

CHICAGO ACADEMY OF SCIENCES.

GLACIAL MARKINGS OF UNUSUAL FORMS

IN THE

LAURENTIAN HILLS.

By EDMUND ANDREWS, M. D., LL.D.

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GLACIAL MARKINGS OF UNUSUAL FORMS IN THE LAURENTIAN HILLS.

By EDMUND ANDREWS, M. D., LL.D.

Two summer vacations spent in camps and canoes where the Laurentian Hills skirt the northeast shore of Lake Huron, have brought to my notice some glacial phenomena of very unusual forms.

These hills are for the most part ranges of hard metamorphic rock, which at the boulder drift period were scraped bare and washed clean of all earthy covering, so that the present forests grow mostly in a thin stratum of vegetable mold of later origin. The irregular and knobby eminences, as the country slopes gradually beneath the level of Lake Huron, project their countless summits above the water in a wide belt of wooded islands, which extend along the coast some two hundred and fifty miles. The British chart (Bayfield's original) marked fifty-two thousand of these islands. The rocks along the coast are mostly white quartzite and gneiss, and are everywhere covered with glacial markings which are often of peculiar forms. North and northeast of Grand Manitoulin Island the Cloche Mountains stretch east and west about thirty miles along the coast. These mountains are of white quartzite, and the strata are nearly perpendicular, with the strike parallel to the range, that is, east and west. They are covered everywhere with striations which, owing to the intense hardness of the material, retain their forms with beautiful distinctness.

CURVED STRIÆ.

Among the interesting phenomena of the region are the thousands of curved striations. Fig. 1 is from the stream that comes down by the Hudson's Bay Post, about fifteen rods above the cascade. There is a broad gap here in the Cloche range, through which some fine lakes lying behind the mountains send their surplus waters to Lake Huron. The stream apparently ran in the same bed before the drift period, for the little gorge at D, (indicated in the figure by shading,) scarcely ten feet deep, is well scored to the very bottom with glacial striæ following all the sinuosities of the stream. The general course of the striæ of the gap is southward. The perpendicular lines in the figure indicate this general direction, while the curved lines in the shading of the gorge (D) show how the striæ bend abruptly in order to follow around the hard quartzite banks of the stream, and, in doing so, even run a little contrary to the main course of the glaciation.

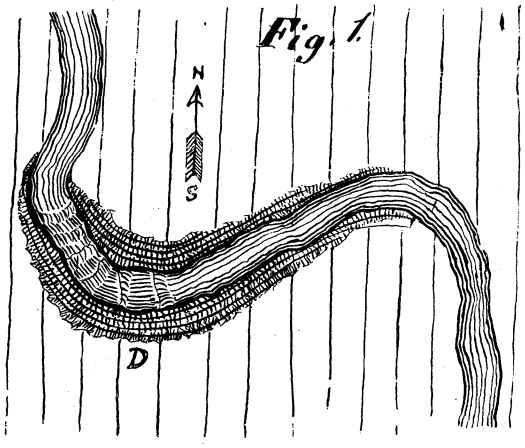


Fig. 1.

The crest of the Cloche Mountains is crossed by a multitude of giant grooves, some of which reach a depth of six feet and are twenty feet across. These markings run southward, rounding slightly over the summit of the range and down its slopes, until they reach the crests of its southern precipices, where they terminate abruptly, as it were sailing away into the air and not forming any grooves down its face.

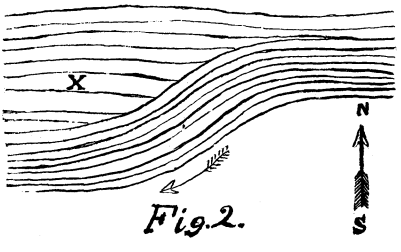


Fig. 2.

Sixty miles southeast of the Cloche gap, and off the mouth of French River, there lies outside of the general insular belt a beautiful cluster of wooded islets, the Bustard Isles. The group consists of about two hundred *roches moutonnées*, upon which sufficient vegetable mold has accumulated to support a growth of trees. Wherever this soil has been washed away by the waves, the striæ come to view.

Fig 2 was sketched from a sample of curved markings near one of my camps on the north side of the group. The sketch represents about fifteen feet of the length of the marks. It is not easy to see any reason for the curve, as there was no prominence of rock in the direction of x to turn the ice. In fact the islet was highest on the side toward which the ice turned at the first curve. The compass-mark is approximately, but not precisely correct.

Fig. 3.

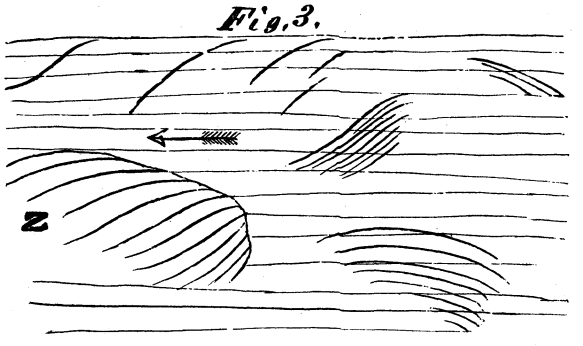
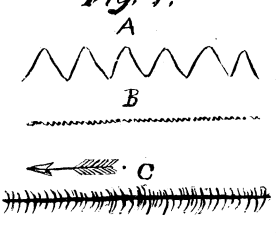


Fig. 3 is copied from my notes of observation on striæ found at Negaunee, in northern Michigan. A knob of rock uncovered by iron-miners was of such material that it showed on its irregular surface the finest markings, even to hair-lines.

There were upon this rock some curves, which were evidently deflections caused by knobs and bosses on its surface, as for instance at z, while other markings were erratic, and curved without obvious cause, as though the ice had been swayed by swirling currents as the waters moved about it. The most of the glaciation was in the direction shown by the horizontal lines. The curved lines in the figure were selected from hundreds of others on a surface of about two rods square. They were generally short, and some of the curves were of less than one foot radius.

SERRATED STRIÆ.

Fig. 4.



Behind the Cloche Mountains the Spanish River runs westward into Lake Huron. A branch of this stream, called the Sable, coming down from the hills on the north, presents near its mouth five cataracts within a distance of eight miles. At the lowest of the falls the river runs through a sort of rock flume, having upon both sides walls about forty feet in height, not quite vertical but with a slight inclination away from the stream. These cliffs are smooth and striated in every part parallel to the stream. At the falls, which are only a few

feet in height, the striæ curve with the descent, and also laterally with a bend of the cliff. On the walls of the gorge are to be seen a few examples of the marks A and B, fig. 4, and the mark A is serrated, the serrations being perhaps twelve inches high.

It is not easy to explain the cause of these striæ in a perfectly satisfactory manner, but it would seem that some of the ice must have been driven through the flume with a rocking motion, so that the boulders on its lateral margins were caused to take a zigzag course, scoring the walls in a corresponding form. In B, fig. 4, is represented a section of certain marks produced in the same manner as those cuts of a stone-planing engine where the tool trembles or vibrates in the grasp of the machine so as to cut a finely serrated groove. In the specimens found the serrations were about one-quarter of a centimetre from crest to crest. It is possible that the regular vibrations there recorded on the rocks had some fixed mathematical relation to the velocity of the ice, which might be determined by calculation or experiment.

NEW INDEX OF THE DIRECTION OF MOTION.

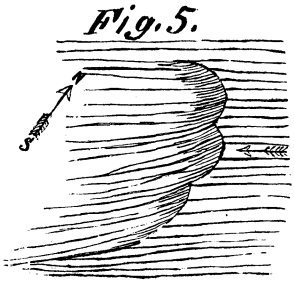
The mark C, fig. 4, was copied from a granite *roche moutonneé*, at the fishing hamlet of Killarney, near some quartzite ranges named "Killarney Mountains." Striæ of this type show a multitude of minute cracks, extending laterally and curved so as to present their points forward in the direction of the glacial movements. Only large grooves and scratches show this peculiarity. It is a very convenient mode of determining the direction of the motion, for the pressure of the boulders which made the scratches as they moved forward, caused the transverse crevices to present their concave sides always forward. It is well known to engineers that in brittle substances the forms assumed by fracture vary with velocity of the impact, so that there is probably a time relation involved here also, which would make it possible to determine the approximate velocity of the ice which carried the boulders. Such a calculation, if based upon carefully repeated experiments, might prove an important contribution to our scanty knowledge of the Drift Period.

SCOOP-MARKS.

These are singular phenomena, and very difficult of explanation. They are of two varieties, the striated and the unstriated. Fig. 5 is a diagram intended to illustrate a typical form of the striated variety. The marks consist of shallow, elongated excavations, or troughs,

which may be many feet in width. They run nearly in the direction of the general striation of the locality, and look as though a huge flour-scoop had been inserted into the rock and had cut out enough of its substance to make a smooth and rather shallow concave channel. The end toward the east or northeast, from whence the drift action came, is abrubt, sharply defined, and, although the angle of junction with the general surface is obtuse, yet this line of junction is a sharp and clearly-cut edge, and not a gradual sloping or rounding into the general level. The interior of the concavity is well striated in the direction of its own length, but the scratches are never continuous with those of the general surface northeast of the head of the scoop-mark; and conversely the striæ of the general glaciated surface are all cut off abruptly at the head of the scoop, and never descend at all into it.

Fig. 5.

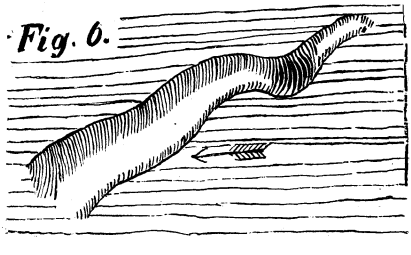


The tail of the channel grows shallower as it runs west or southwestward, and its thin extremity merges imperceptibly into the glaciated surrounding surface.

A few of the scoop-marks are nearly flat in contour, and are only recognizable where they cut abruptly through at an obtuse angle into the general face of the rocks. The interpretation of these anomalous scoop-marks is somewhat perplexing. At least, after considerable study of them, I am quite unable to frame a plausible theory of their origin other than the general one, that ice was the agent.

The unstriated scoop-marks differ considerably from the others in form, and on the average are smaller, seldom exceeding two feet in breadth. There are no glacial markings in their smooth but unpolished concavities.

Fig. 6.



Whether they never contained any striations, or whether the markings have been erased by sand and water driven through them before the Drift Period closed, is not easily determined. These channels generally are crooked, without obvious reason (see Fig. 6), and are narrowest at the end toward the northeast, from which direction the drift came. Toward the opposite extremity they grow wider and more shallow,

disappearing finally and vaguely into the general ice-marked surface of the locality. The specimen shown in fig. 6 is, perhaps, six feet long, sunk in granite, without any crevice, vein or visible irregularity in the rock face to account for its excavation at that spot. These channels often differ pretty widely in direction from the adjacent striation, and the end nearest the northeast commences as a rounded depression, without the clear-cut edge presented by the striated scoop-marks. The darkly shaded spot in fig. 6 was deeper than the rest, as if from a species of "pothole" action.

Most of the striated scoop-marks are not independent phenomena, like fig. 6, but evidently are appendages to adjacent knobs and projections of rock. The type of such cases is represented in fig. 7, which is a diagram of the plan of numerous specimens seen along the eastern shore from Killarney to Parry Sound, a distance of about one hundred miles. K is a boss or knob of rock projecting above the general glaciated surface in an oval form, in fact a *roche moutonneé*. The specimen in fig. 7 is about four feet high, fifteen feet wide and thirty long, but the sizes of others vary without any obvious rule. The observed specimens are mostly in gneiss. The horizontal lines in the diagram show the general direction of the striation in the locality — nearly west-southwest as shown by the arrow. It will be seen that as the striæ approach and rise upon the surface of the knob they are deflected to the right and left, and sweep over it in an oblique course. This sort of curved deflection, partly over and partly around obstacles, is common to the whole coast, so that in many places almost all the striæ are curved by the influence of the knobby surfaces of the gneiss and quartzite.

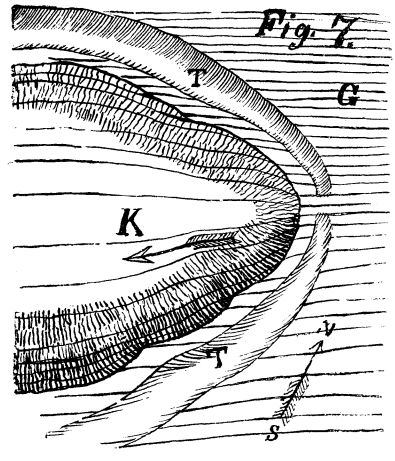


Fig. 7.

T T are two unstriated scoop-marks, having a length of about ten feet and a width of twelve inches. They begin vaguely near to each other, but not in contact, close to the northeast end of the knob, and rapidly deepen to six inches or more as they curve about its two sides, after which they grow wider and more shallow until they become lost in the general glaciation along the sides of the rocky buttress. There are no striæ in these concavities, and their inner

borders do not touch the base of the knob, but keep a foot or more away from it, leaving a narrow strip of level striated rock between the margins of the troughs and the eminence.

In a multitude of cases, just as in this one, it is sufficiently clear that the resistance offered by knobs of rock to the progress of the drift agencies in some way determined the presence and direction of these scoop-marks.

The great belt of fifty-two thousand islands, above referred to, varies from three to fifteen miles in width, and is about two hundred and fifty miles long. Beginning at the Ste. Marie river, it first outlines the north channel by the great Manitoulin group, and thence passing southeast through Frazer Bay, continues along the whole east coast of Georgian Bay and terminates near Collingwood.

Near the mainland, the islands are mostly metamorphic, with a very distorted stratification, but a few of those on the lakeward border of the belt are of Silurian limestone, with the strata dipping gently away from the nearest metamorphic hills.

This almost untrodden solitude, which has lain forgotten by the crowds of summer pleasure-seekers, is well worthy of a visit by the lover of nature. The magnificent panoramas of the island belt, as viewed from the summit of the LaCloche and Killarney ranges, are unique, and in themselves well worth the journey to the region. Fortunately, they are as yet almost unknown to sight-seers, and still remain in their original freshness and silence.

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